REMARKS

The amendment and remarks are presented for the Examiner's consideration. The amendments to claim 50 and 61 address the § 112, 2nd paragraph rejection by clarifying how the cap layer reduces reflectivity of light from photolithographic processes. Amendments to other claims correct typographical errors, antecedent bases and clarity issues. No additional search is believed required by these amendments and no new matter is added thereby. Entry of these amendments, thereby either allowing for withdrawal of the rejections or narrowing of the issues for appeal, is respectfully requested.

I. Status of Claims

Claims 50–93 are pending in the application. Original claims 1–20 and later added claims 21–49 were cancelled. No claims have been allowed. Claims 50, 52–55, 59–61, and 63–69 stand rejected under 35 U.S.C. § 102(e), or in the alternative, under 35 U.S.C. § 103(a) over U.S. Patent No. 5,854,126 to *Tobben et al.* Claims 56–58 stand rejected under 35 U.S.C. § 103(a) over *Tobben*.

In addition, claims 50–93 stand rejected under 35 U.S.C. § 112, 1st paragraph, as lacking support in the specification. Claims 80–93 also stand rejected under 35 U.S.C. § 112, 1st paragraph, the Examiner contending: (1) "adjustable etching component" is not clearly defined; (2) the adjustment of the etching component to achieve a desired result lacks enablement; (3) "first plasma based process" and "second plasma based process" constitute new matter; and (4) processes other than high density plasma chemical vapor deposition for the first plasma based process lack enablement.

Claims 61–64, 66–74 and 79 also stand rejected under 35 U.S.C. § 112, 2nd paragraph, as failing to recite process steps resulting in gaps being filled. Claims 50–79 also stand rejected under 35 U.S.C. § 112, 2nd paragraph, based on the contention that the phrase "to reduce reflectivity of light passing through such cap" is subjective and does not futher define the claim. Claims 70–73 and 75–78 also stand rejected under 35 U.S.C. § 112, 2nd paragraph, on the ground that the term "antireflective coating" lacks proper antecedent basis. Lastly, claims 80-93 also stand rejected under 35 U.S.C. § 112, 2nd paragraph, on the ground

that the word "based" fails to further limit or define "plasma" or "process."

II. Status of Amendments

Claims 50 and 61 are amended herein to clarify the term "sufficient to reduce reflectivity of light passing through said cap layer" and correct typographical errors. Support for the amendment can be found in the specification on page 11, lines 7–29. Claims 54 and 64 are amended to clarify the oxynitride is silicon oxynitride. Claims 70, 73, 75 and 78 are amended to provide antecedent basis for the antireflective coating. Claim 71 is amended to depend from claim 70. Claim 76 is amended to depend from claim 75. Finally, claim 79 is amended to depend from claim 50. These amendments address the 35 U.S.C. § 112, 2nd paragraph rejection of claims 50-79, 70-73 and 75-78.

III. Summary of the Invention

Briefly stated, the invention is directed toward a method for forming conducting structures separated by gaps on a substrate. Specification, page 5, lines 3–4. The gaps may be filled with dielectric materials to reduce capacitance between adjacent wiring lines and between wiring lines on different layers. Specification, page 3, lines 20–24 and page 5, lines 10–11.

Unfortunately, gaps with high aspect ratios (*i.e.*, a high ratio of gap height to gap width) are difficult to fill with dielectric material using conventional chemical vapor deposition (CVD) techniques, because these techniques tend to form voids in the gaps. Specification, page 6, lines 11–15. The present invention addresses this problem with a gap filling process that uses high-density plasma chemical vapor deposition (HDPCVD) to fill substantially all of a gap. Specification, page 6, lines 16–21.

While HDPCVD is a preferred CVD technique to fill gaps according to the invention, there is nothing in the specification that forbids the use of HDPCVD with other CVD techniques. Specification, page 9, lines 11–13 (noting that variations on the process of forming a cap layer and performing an HDPCVD step may be desirable). For example, Figure 4 and the accompanying description in the specification include using HDPCVD to fill the high aspect ratio portion of gap 36 and conventional plasma-enhanced chemical vapor deposition (PECVD) to form a top portion of gap 36. Specification, page 12, line 26 to page 13, line 5;

see also Figure 4. This combination combines the advantages of the superior filling qualities of HDPCVD with the faster filling speeds of PECVD. *See id.*

Multiple layers may be used to help form the conducing structures on the substrate, including a cap layer, a protective coating layer, a metal layer and a glue layer disposed over the substrate. Specification, page 6, lines 23–25. In one embodiment, cap layer (28) serves, among other functions, to block reflected light from reaching portions of a photoresist layer that should remain unexposed. Specification, page 11, lines 3–7. Cap layer (28) does not just absorb the reflected light, it also takes advantage of the wave nature of light to block the reflections by destructive interference. Specification, page 11, lines 6–8.

In order to block reflected light from photolithographic processes, cap layer (28) is formed like a quarter wave plate that is set to a thickness such that twice the thickness of the layer equals an odd number of half wavelengths (*i.e.*, $\lambda/2$) of the reflected light. Specification, page 11, lines 13–15. For cap layer (28) to be most effective at blocking light by destructive interference, the thickness of the layer should be uniform. Specification, page 11, lines 16–17.

Cap layer (28) is also formulated to have a dielectric constant that is close to the dielectric constant of an underlying layer. Specification, page 11, lines 25–29. Reducing the difference between the dielectric constants of these layers reduces the amount of light reflected at the interface of these layers. Specification, page 11, lines 23-25.

IV. Issues

1. Whether claims 50, 52-55, 59–61 and 63–69 are unpatentable under 35 U.S.C. § 102(e) or § 103(a) over *Tobben* (U.S. Patent No. 5,854,126).

2. Whether claims 56–58 are unpatentable under 35 U.S.C. § 103(a) over *Tobben*.

3. Whether claims 50–93 are unpatentable under 35 U.S.C. § 112, 1st paragraph, for lack of support in the specification.

4. Whether claims 80–93 are unpatentable under 35 U.S.C. § 112, 1st paragraph, because the term "adjustable etching component" is not supported or enabled by the specification.

5. Whether claims 80–93 are unpatentable under 35 U.S.C. § 112, 1st paragraph, because the term "plasma based process" is not supported by the specification.

6. Whether claims 80–93 are unpatentable under 35 U.S.C. § 112, 1st paragraph, because the specification only enables HDPCVD as the "first plasma based process".

7. Whether claims 80–93 are unpatentable under 35 U.S.C. § 112, 2nd paragraph, because the word "based" fails to futher limit or define "plasma" or "process".

8. Whether claims 61–64, 66–74 and 79 are unpatentable under 35 U.S.C. § 112, 2nd paragraph, because they fail to recite process steps resulting in gaps being filled.

9. Whether claims 70–73 and 75–78 are unpatentable under 35 U.S.C. § 112, 2nd paragraph, because the term "antireflective coating" lacks proper antecedent basis.

10. Whether claims 50–79 are unpatentable under 35 U.S.C. § 112, 2nd paragraph, because the term "to reduce reflectivity of light passing through such cap" fails to futher define the claim.

V. Argument

A. The rejection of claims 50, 52–55, 59–61 and 63–69 under 35 U.S.C. § 102(b)/103(a) is deficient because *Tobben* fails to teach or suggest all of the elements of independent claims 50 and 61.

Independent claims 50 and 61, as amended, each recite the limitation "wherein said cap layer has a uniform thickness and a composition which are adapted so that during a photolithographic process an amount of light reflected at an interface of the cap layer with an underlying layer is less than an amount of light reflected at an interface with the underlying layer if the cap layer is not

present." This limitation distinguishes claims 50 and 61 from *Tobben* because the cap layer of *Tobben* (planarization layer 16) of non-uniform thickness. *See Tobben*, Figs. 2–5, layer #16.

The non-uniform cap layer of *Tobben* is not effective for preventing reflected from exposing photoresist layers by destructive interference like the cap layer of the present invent. *See* specification, page 11, lines 13–15 (noting cap layer is most effective for blocking reflected light when it has uniform thickness) Moreover, *Tobben* never suggests that the wave nature of light can be exploited to reduce light intensity by destructive interference. Thus, *Tobben* not only lacks a cap layer of uniform thickness, the reference provides no motivation to make the cap layer a uniform thickness.

When making a claim rejection based on prior art, the Examiner, not the Applicant, has the initial burden of showing where every limitation of the claim is described or suggested in the prior art. *See, e.g.*, MPEP § 2142 ("The Examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness."). In the Final Office Action, the Examiner simply ignores the fact that claims 50 and 61 require a cap layer of uniform thickness.

In addition, claims 50 and 61 are amended to clarify that the cap layer has a composition which is adapted so that during a photolithographic process an amount of light reflected at an interface of the cap layer with an underlying layer is less than an amount of light reflected at an interface with the underlying layer if the cap layer is not present. *Tobben* does not suggest that the cap layer described there could function as an anti-reflective layer.

This function comes about by selecting materials for a cap layer with dielectric constants that are close to the dielectric constant in an underlying layer. Specification page 11, lines 25–29. The function is not inherently present for every cap layer regardless of composition, and it is not described nor suggested for the cap layer in *Tobben*. Thus, because there is at best only an unmentioned possibility that the cap layer in *Tobben* functions as an anti-reflective layer, this limitation is not inherently described by the reference. See, e.g., In re Oelrich, 666 F.2d 578 (CCPA 1981) (noting that it is well settled that inherency may not

be established by mere probabilities or possibilities regarding what may have resulted in the prior art.)

Because the Examiner has not shown where *Tobben* describes or suggests having a cap layer with uniform thickness or composition that reduces the amount of light reflected by a photolithographic process, withdrawal of the rejection of claims 50 and 61 under 35 U.S.C. § 102(e) or § 103(a) over *Tobben* is proper and respectfully requested. Similarly, withdrawal the rejection of claims 52–55, 59–60, and 63–69, which depend from independent claims 50 and 61, is respectfully requested.

B. The rejection of claims 56–58 under 35 U.S.C. § 103(a) is deficient because *Tobben* fails to show all of the elements of independent claim 50.

Claims 56–58 depend from independent claim 50, and therefore include all the limitations of claim 50. As noted above, claim 50 includes a cap layer of uniform thickness that is neither described nor suggested by *Tobben*. Accordingly, withdrawal of the rejection of claims 56–58 under 35 U.S.C. § 103(a) over *Tobben* is respectfully requested.

C. The rejection of claims 50–93 under 35 U.S.C. § 112, 1st paragraph, is deficient because there is support for the claims in the specification.

Claims 50–93 were rejected under 35 U.S.C. § 112, 1st paragraph, Examiner contending lack of support for claims 50 and 61, as amended, and new claim 80. This rejection is traversed.

The limitation "cap layer has a uniform thickness which is sufficient to reduce reflectivity of light passing through such cap layer" added by the amendment to clams 50 and 61 is fully supported by the discussion in the specification of cap layer (28) blocking reflected light by destructive interference at page 11, lines 3–19.

The clarification that dielectric material is deposited "on surfaces exposed by the etching process including exposed surfaces of the cap layer" added by the amendment to claims 50 and 61 is fully supported by Figure 3 which shows dielectric layer (38) formed on top of cap layer (28). The discussion of Figure 3 in

the specification at page 12, lines 16-19, clearly states that both etching and deposition are occurring as dielectric layer (38) is being formed on cap layer (28) by HDPCVD.

The discussion of HDPCVD etching and dielectric material deposition also supports the limitation "wherein the cap layer acts to protect the wiring lines and portions of the cap layer are sacrificially removed during the process of depositing the dielectric material" added by the amendment to claims 50 and 61. This discussion states that "[t]he etching occurs because of the sputter component discussed above, which causes a portion of cap layer 28 to being etched away along its sides and top surface." *See* page 12, lines 21–23. The statement clearly supports portions of the cap layer being sacrificially removed during the process of depositing dielectric material.

Regarding claim 80, most of the elements of this claim are supported by original independent claims 1 and 9, except for the following limitation:

> depositing a dielectric material to substantially fill said gaps, including using a first plasma based process having both a deposition component and an adjustable etching component at least until any high aspect ratio gaps are substantially filled, followed by a second plasma based process that fills any remaining portion of said gaps and results in a planarized surface, and which second plasma based process does not include an adjustable etching component.

Support for this limitation can be found in Figure 4 and the accompanying discussion in the specification. In particular the specification at page 12, line 26 to page 13, line 8, states that dielectric layer (38) is deposited into gaps (36) by HDPCVD until they are substantially filled, and then a second layer (40) may be deposited on top of layer (38) by PECVD.

Elsewhere in the specification it is noted that the etching component of the HDPCVD deposition process may be controlled (*i.e.*, adjusted) to avoid the formation of the small gaps in the dielectric layer that are observed in other deposition methods such as PECVD. Page 7, lines 3–14. Thus, the specification supports depositing dielectric material to substantially fill gaps that includes using a first plasma based process having both a deposition component and an adjustable etching component until at least any high aspect ratio gaps are

substantially filled (*e.g.*, HDPCVD), followed by a second plasma based process that fills any remaining portion of said gaps and results in a planarized surface, and which the second plasma based process does not include an adjustable etching component (*e.g.*, PECVD).

Thus, all limitations of claims 50, 61 and 80 are fully supported by the specification and original claims. Accordingly, withdrawal of the rejection of claims 50–93 under 35 U.S.C. § 112, 1st paragraph is respectfully requested.

D. The rejection of claims 80–93 under 35 U.S.C. § 112, 1st paragraph, is deficient because there is support and enablement for the phrase "adjustable etching component".

Claims 80–93 were rejected under 35 U.S.C. § 112, 1st paragraph because, according to the Examiner, the claim term "adjustable etching component" was not clearly defined and not enabled. This rejection is traversed.

The specification at page 7, lines 3-11 notes that manipulating a relative substrate bias can alter the deposition conditions in HDPCVD, altering the extent to which etching processes occur during deposition:

> The high density plasma, which mediates deposition in HDPCVD systems, may be generated from a variety of sources such as electron cyclotron resonance, inductively coupled plasma, helicon, and electrostatically shielded radio frequency. All of these plasma generation mechanisms allow for the addition and independent control of a bias sputter component to the deposition process. Manipulating the relative substrate bias can alter the deposition conditions, altering the energy of the CVD precursor gases and the extent to which etching and sputtering processes occur during deposition. Control of the substrate bias makes it possible to achieve substantially void-free gap filling with enhanced planarization in an intermetal dielectric deposition process. (emphasis added)

One of skill in the art would reasonably conclude that manipulating the substrate bias to alter the extent of etching during deposition describes an etching component that is adjustable. Furthermore, the description enables one of skill in the art to adjust the etching component in plasma based deposition processes without undue experimentation. Accordingly, withdrawal of the

rejection of claims 80–93 under 35 U.S.C. § 112, 1st paragraph, is respectfully requested.

E. The rejection of claims 80–93 under 35 U.S.C. § 112, 1st paragraph, is deficient because there is support in the specification for a "plasma based process".

Claims 80–93 were again rejected under 35 U.S.C. § 112, 1st paragraph, because, according to the Examiner, the term "plasma based process" is not supported in the specification. This rejection is traversed.

> The term "plasma based process" is identically recited in the specification:
>
> It should be recognized that any plasma based process can exhibit sputter etching and deposition mechanisms. When the present inventors discussing sputtering rates in HDPCVD processes, the present inventors intend to convey a sputtering rate in comparison to a base line level of sputtering characteristic of a process such as PECVD.

See specification, page 8, lines 12–16 (emphasis added).

One of skill in the art would unmistakably conclude from this passage that plasma based processes are contemplated by the present invention, and that plasma based processes include HDPCVD processes as well as conventional plasma based processes like PECVD. Accordingly, the rejection of claims 80–93 under 35 U.S.C. § 112, 1st paragraph, for lack of support of the term "plasma based process" should be withdrawn.

F. The rejection of claims 80–93 under 35 U.S.C. § 112, 1st paragraph, is deficient because processes other than HDPCVD are enabled for the "first plasma based process."

Claims 80–93 were also rejected under 35 U.S.C. § 112, 1st paragraph, because according to the Examiner, the specification only enables HDPCVD as the "first plasma based process". This rejection is traversed.

One of skill in the art would recognize that HDPCVD is simply a contemporary label for a type of system that has both an adjustable etching and deposition component. The application is broadly enabling to those of skilled in the art to practice a variety of processes that employ a combination of these components, regardless of whether the process is called HDPCVD. Withdrawal

of this rejection of claims 80–93 under 35 U.S.C. § 112, 1st paragraph, is respectfully requested.

G. The rejection of claims 80–93 under 35 U.S.C. § 112, 2nd paragraph, is deficient because the word "based" further limits or defines "plasma" and "process".

Claims 80–93 have been rejected under 35 U.S.C. § 112, 2nd paragraph, because according to the Examiner it is unclear how the word "based" further limits or defines the words "plasma" or "process" in the claim term "plasma based process." This rejection is traversed.

As noted above, the term "plasma based process" is explicitly recited in the specification and one of skill in the art reading the specification would understand that plasma based processes are processes that use some form of plasma to effectuate work on the substrate. Furthermore, plasma based processes have been used in semiconductor fabrication for material deposition, sputtering, cleaning and etching. Thus, one of skill in the art considering the term "plasma based process" in the context of the claims as a whole would be apprised of the scope of the claims, which is all that is required by 35 U.S.C. § 112, 2nd paragraph. *See* MPEP § 2173.02-03. Accordingly, withdrawal of the rejection of claims 80–93 under 35 U.S.C. § 112, 2nd paragraph, is respectfully requested.

H. The rejection of claims 61–64, 66–74 and 79 under 35 U.S.C. § 112, 2nd paragraph, because the claims do not recite process steps resulting in gaps being filled is made moot by amendment.

Claims 61–64, 66–74 and 79 have been rejected under 35 U.S.C. § 112, 2nd paragraph, because claim 61 recites a process step where a gap is filled as stated in the preamble of the claim. Claim 61 has been amended to provide antecedent basis connecting the HDPCVD dielectric material layer formed on the surfaces exposed by the etching process to the dielectric material that fills the gaps recited in the preamble. Accordingly, withdrawal of the rejection is respectfully requested.

I. The rejection of claims 50–79 under 35 U.S.C. § 112, 2nd paragraph, because the term "to reduce reflectivity of light passing through the cap" further defines the claims is made moot by amendment.

Claims 50–79 have been rejected under 35 U.S.C. § 112, 2nd paragraph, because the claim term "to reduce reflectivity of light passing through the cap" is subjective and fails to further define the claim. The amendment to claims 50 and 61 clarifies that the cap layer is "adapted so that during a photolithographic process an amount of light reflected at an interface of the cap layer with an underlying layer is less than an amount of light reflected at an interface with the underlying layer if the cap layer is not present." Accordingly, the rejection is made moot by the amendment.

J. The rejection of claims 70–73 and 75–78 under 35 U.S.C. § 112, 2nd paragraph, because the term "antireflective coating" lacks antecedent basis is made moot by amendment.

Claims 70–73 and 75–78 have been rejected under 35 U.S.C. § 112, 2nd paragraph, because the term "antireflective coating" lacks proper antecedent basis. Claims 70, 72, and 73 have been amended to provide proper antecedent basis for the antireflective coating. In addition, claims 75 and 78 have been amended to depend from claim 52, providing proper antecedent basis for the antireflective coating in claims 75–78. Accordingly, withdrawal of the rejection is respectfully requested.

VI. Conclusion

In view of all of the above, claims 50–93 are believed to be allowable and the case in condition for allowance, which action is respectfully requested. Should the Examiner be of the opinion that a telephone conference would expedite the prosecution of this case, the Examiner is requested to contact Applicants' attorney at the telephone number listed below.

No fees are believed to be required with this Response, and should any be required, please charge Deposit Account 50-1123. Should any extension of time

be required, please consider this a petition therefore and charge the required fee to Deposit Account 50-1123.

Respectfully submitted,

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